

REMARKSAmendments

Claim 1 has been amended to recite that the variable resistive element comprises a plurality of variable resistive elements, at least some of which are connected in series. Basis is found in paragraph [0021] of the specification and in claim 4. In addition, a typographical error has been corrected in claim 1. These amendments have been made in the interest of rapid prosecution and without prejudice to Applicants' right to prosecute claims of similar or different scope to the unamended claims in one or more continuation applications.

The Objection to the Specification

Applicants respectfully traverse the objection to claim 1 in view of the amendment to the word "statue" in the claim. Claim 1 has been amended to correct the typographical error noted by the Examiner.

The Rejection Under 35 USC § 103(a)

Applicants respectfully traverse the rejection of claims 1, 2, 4-7, 10, and 11 under 35 USC § 103(a) as unpatentable over Atsushi (Japanese Publication No. 2000-152516) in view of Sato (U.S. Patent No. 6,700,766) and further in view of Myong et al. (U.S. Patent No. 6,356,424), insofar as the rejection is applicable to the amended claims.

The present claims are directed to an overheat protection device for use in providing overcharge protection to a secondary (i.e. rechargeable) battery. The overheat protection device comprises a variable resistive element which is a polymer PTC element that changes resistance as a function of temperature. The variable resistive element is composed of a plurality of variable resistive elements, at least some of which are electrically connected in series with each other. The device further comprises a switching element which controls a current flowing through an electrical system depending on an applied voltage thereto, and a resistor. The variable resistive element is located on and thermally combined with a certain position of the electrical system and interrupts the current flowing through the electrical system by changing the applied voltage to the switching element when the certain position comes to be under a high temperature condition.

As previously stated, in contrast to conventional systems in which detection of a temperature anomaly and the restriction of current once the temperature anomaly is detected is done by the variable resistive element only, the present claims recite a device in which the variable resistive element is used in combination with the switching element and the resistor. The variable resistive element changes the applied voltage to the switching element and interrupts the current flowing through the system. The relationship between the resistance of the variable resistive element and the resistor is $R/P_L > 10$ and $R/P_H < 1/10$, where P_H and P_L are the resistances of the variable resistive in a high temperature state and in a low temperature state, respectively. It is thus possible to effectively prevent the overheating by promptly detecting the temperature anomaly of the electrical system while the decrease in power efficiency of the electrical system is low. Because a plurality of variable resistive elements are used and can be positioned on various portions of the electrical system, and because, in contrast to ceramic PTC devices, polymer PTC elements increase significantly, i.e. several decades, in resistance over a very narrow temperature range, it is possible to provide switching over a narrow range and to identify a number of different hot spots using a single detection circuit.

Atsushi discloses a battery pack protection device in which a resistor (21A) is connected in series with a ceramic thermistor (21B), and the combination is connected in parallel with a battery. A switching circuit including a FET is connected in series with battery. As the Examiner states, Atsushi does not teach the presence of a polymer PTC element. Neither does Atsushi teach that the relationship between the resistor and the variable resistor should be $R/P_L > 10$ and $R/P_H < 1/10$. Finally, Atsushi does not teach the use of a plurality of variable resistive elements.

The deficiencies of Atsushi are not resolved by the addition of Sato. Sato discloses a protection circuit including a polymer PTC device and a diode connected in series and in thermal proximity with each other. As with Atsushi, there is no teaching or suggestion that the relationship between the resistor and the variable resistor should be $R/P_L > 10$ and $R/P_H < 1/10$, still less that a variable resistive element should comprise a plurality of variable resistive elements connected in series in order to provide the ability to identify a number of different hot spots.

The deficiencies of Atsushi and Sato are not resolved by the addition of Myong et al. Myong discloses an electrical protection system in which (a) a PTC device which can be a polymer PTC device is thermally coupled with a resistive device, and (b) a relay coil is coupled

with relay contacts, the series combination of (a) and (b) resulting in a control element. There is no disclosure or suggestion that the relationship between the resistor and the variable resistor should be $R/P_L > 10$ and $R/P_H < 1/10$ in order to achieve satisfactory performance, and no disclosure that a plurality of variable resistive elements could or should be used.

The Examiner agrees that the combination of Atsushi and Sato does not teach the plurality of variable resistive elements. However, the Examiner contends that it would be an obvious and trivial modification to use such a plurality of devices. Applicants disagree. Rather than being a “mere duplication of the essential working parts of the device” involving “only routine skill in the art”, the use of a plurality of devices allows an advantage definitely not taught or suggested in the art, i.e. the ability to identify a number of different hot spots using a single detection circuit. Thus, Applicants believe the rejection is unfounded.

Conclusion

It is believed that this application is now in condition for allowance and such action at an early date is earnestly requested. If, however, there are any outstanding issues which can be usefully discussed by telephone, the Examiner is asked to call the undersigned.

Respectfully submitted,

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